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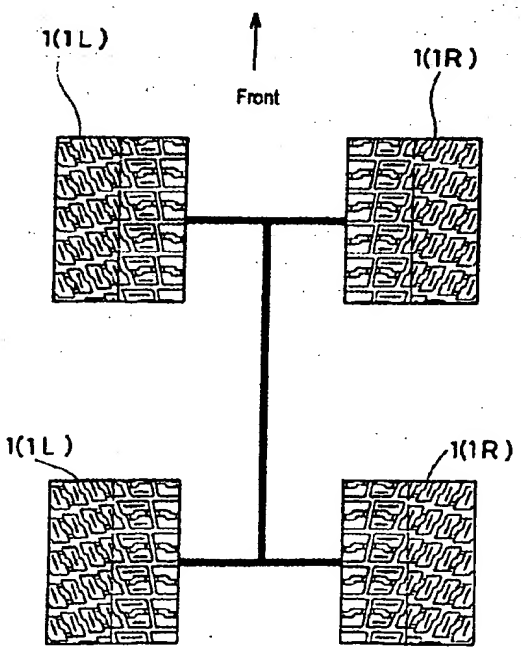
(54) Vehicle tyre

(57) A vehicle tyre comprising a tread having an outside tread edge (To) and an inside tread edge (Ti) to be placed on the outside and inside of a vehicle, respectively, the tread comprising an inside tread part extending from the inside tread edge (Ti) toward the tyre equator (C), and an outside tread part extending from the outside tread edge (To) toward the tyre equator (C), the inside tread part being provided with inside axial grooves (5) extending axially across this part so as to circumferentially divide this part into inside blocks (Bi), the outside tread part being provided with outside axial grooves (3) extending axially across this part, and outside circumferential grooves (6) each extending between the circumferentially adjacent outside axial grooves so as to circumferentially and axially divide this part into outside blocks (Bo), characterised in that when looking down on the tyre, the outside axial grooves (3) are inclined towards one direction such that the outer ends (o1) thereof are positioned backward of the inner ends (i1) in respect of the intended travelling direction, the inclination angle α of the outside axial grooves (3) is in the range of from 60 to 80 degrees with respect to the tyre equator (C), the outside circumferential grooves (6) are inclined toward one direction such that the outer ends (o3) thereof are positioned forward of the inner ends (i3), the inclination angle γ of the outside circumferential grooves (6) is in the range of from 15 to 45 degrees with respect to the tyre equator (C), the inside axial grooves (5) are inclined at an angle β of 80 to 110 degrees with respect to the tyre equator (C).

See Fig 3

Fig.1



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Description

[0001] The present invention relates to a vehicle tyre having an improved tread pattern capable of improving off-road grip such as traction and side grip, and more particularly to asymmetrical tread patterns specialised for right tyre and left tyre.

[0002] Many attempts have been made to improve road grip properties during off-road running such as side grip, traction, braking and the like, and it has been believed that the important factors are the inclination of the edges of the tread elements such as blocks and the like, namely the inclination of the tread grooves defining such elements, and the lengths of the edges. Hitherto, therefore, when much importance is attached to traction performance, the total length of the axially extending edges has been increased. On the other hand, when more importance is attached to side grip performance, the total length of the circumferentially extending edges has been increased. But it is difficult to effectively improve the road grip in all directions, that is the travelling direction and the side direction at the same time.

[0003] It is therefore, an object of the present invention to provide vehicle tyres, in which both off-road grip performances such as traction and side grip are effectively improved.

[0004] The present invention is based on a fact discovered by the inventor, that the outside part of the tread with respect to the vehicle has a greater influence upon the side grip than the inside part, but the inside part has a greater influence upon the traction performance than the outside part. As a result As a result the invention proposes to change the tread pattern between the outside tread part and inside tread part such that the inclination of tread grooves is macroscopically steeper in the outside tread part than the inside tread part.

[0005] According to one aspect of the present invention, a vehicle tyre comprises a tread having an outside tread edge and an inside tread edge which are to be placed on the outside and inside of a vehicle, respectively, the tread comprising an inside tread part extending from the inside tread edge toward the tyre equator, and an outside tread part extending from the outside tread edge toward the tyre equator, the inside tread part being provided with inside axial grooves extending axially across this part so as to circumferentially divide this part into blocks, the outside tread part being provided with outside axial grooves extending axially across this part, and outside circumferential grooves each xtending between the circumferentially adjacent outside axial grooves so as to circumferentially and axially divide this part into blocks, characterised in that, when looking down on the tyre, the outside axial grooves are inclined towards one direction such that the outer ends thereof are positioned backward of the inner ends in respect of an intended travelling direction, the inclination angle α of the outside axial grooves is in the range of from 60 to 80 degrees with respect to the tyre equator C, the outside circumferential grooves are inclined toward one direction such that the outer ends thereof are positioned forward of the inner ends, the inclination angle γ of the outside circumferential grooves is in the range of from 15 to 45 degrees with respect to the tyre equator C, the inside axial grooves are inclined at an angle β of 80 to 110 degrees with respect to the tyre equator C, wherein the direction for measuring the angle β is such that when the angle β is less than 90 degrees, the inclination thereof is the same direction as the outside axial grooves.

[0006] Preferably, the inside tread part is provided with inside circumferential grooves each extending between the circumferentially adjacent inside axial grooves, the inside circumferential grooves being inclined towards the same direction as the outside circumferential grooves, at an angle δ of more than 0 degree with respect to the tyre equator C but less than the angle γ.

[0007] Embodiments of the present invention will now be described in detail in conjunction with the accompanying drawings in which:

Fig.1 shows the relative positions of tyres according to the present invention as fitted to a vehicle;
Fig.2 is a developed plan view of a left tyre showing an example of the tread pattern;
Fig.3 is an enlarged partial view of the tread pattern of Fig.2;
Fig.4 shows a typical basic tread pattern according to the present invention; and
Fig.5 shows the tread pattern of a comparative prior art tread pattern.

[0008] In the drawings, the tyre according to the invention is a pneumatic radial tyre having a relatively low aspect ratio. The tyre comprises a tread portion, a pair of axially spaced bead portions with a bead core therein, a pair of sidewall portions extending between the tread edges and the bead portions, a carcass extending between the bead portions, and a belt disposed radially outside the carcass in the tread portion as usual. However, the applicability of the tread of the invention is not limited to only a pneumatic radial tyre as so described.

[0009] Fig.1 is a schematic view showing four pneumatic tyres 1 (1R and 1L) according to the present invention in the arrangement on a car when looking down on the car from above.

[0010] As shown in this figure, the tread pattern of the right tyre 1R is inverse to that of the left tyre 1L. In other words, the tread pattern of the left tyre 1L and the tread pattern of the right tyre 1R are asymmetrical about the centre line of the car body when they are mounted on the wheel rims of the car. Further, the tread pattern of each tyre 1R, 1L is asymmetric about its own tyre equator.

[0011] Firstly, a type of the tread pattern according to the present invention will now be described according to Fig. 4 which shows the tread pattern of the left tyre 1L when looking down on the tyre.

[0012] The tread portion has an outside tread edge To which is designed to be positioned on the outside of the car, and an inside tread edge Ti to be positioned on the inside of the car. The tread portion comprises an outside part extending from the outside tread edge To to the tread centre, and an inside part extending from the inside tread edge Ti to the tread centre.

[0013] The outside tread part is provided with outside axial grooves 3 extending across the overall width thereof from the outside tread edge To to the vicinity of the tyre equator C, and outside circumferential grooves 6 each extending between the adjacent outside axial grooves 3, whereby this part is divided into outside blocks Bo.

[0014] The inside tread part is provided with inside axial grooves 5 extending across the overall width thereof from the inside tread edge Ti to the vicinity of the tyre equator C, and inside circumferential grooves 7 each extending between the adjacent inside axial grooves 5, whereby this part is divided into inside blocks Bi.

[0015] The outside axial grooves 3 are inclined in one direction such that the outer end ol at the outside tread edge To is positioned backwards of the inner end il when looking down (in the ground contacting patch, accordingly, the outer end ol is forward.) The angle α of the centre line X1 of the outside axial grooves 3 is set in the range of from 60 to 80 degrees with respect to the tyre equator C.

[0016] The outside circumferential grooves 6 are inclined in one direction such that the outer end o3 is positioned forwards of the inner end i3 when looking down. The angle γ of the centre line X3 of the outside circumferential grooves 6 is set in the range of from 15 to 45 degrees with respect to the tyre equator C.

[0017] The inside axial grooves 5 are inclined at an angle β in the range of from of 80 to 110 degrees, preferably about 90 degrees with respect to the tyre equator C. When the angle β is more than 90 degrees, the inclination is reverse to that of the outside axial grooves 3.

[0018] The inside circumferential grooves 7 are inclined in the same direction as the outside circumferential grooves 6. The inclination angle δ thereof with respect to the tyre equator C is more than zero but less than the angle γ, preferably less than 1/2 of the angle γ.

[0019] In the left tyre 1L, as shown in Fig.1-4, the grooves 3 and 6 in the outside part as a whole are more inclined in a counterclockwise direction than the grooves 5 and 7 in the inside part. In the right tyre 1R, in contrast, as shown in Fig.1, the grooves 3 and 6 in the outside part as a whole are more inclined in a clockwise direction than the grooves 5 and 7 in the inside part.

[0020] The number N5 of the inside axial grooves 5 around the tyre is more than the number N3 of the outside axial grooves 3. In this example, N5 is twice N3.

[0021] The number of the inside circumferential grooves 7 counted along one of the inside axial grooves 5 is 1 or 2 and less than the number of the outside circumferential grooves 6 counted along one of the outside axial grooves 3.

[0022] The outside blocks Bo have a shape which is generally a circumferentially elongated parallelogram. On the other hand, the inside blocks Bi have a shape which is generally an axially elongated parallelogram.

[0023] The above-mentioned "vicinity" of the tyre equator C is defined as a tread centre region YC extending from the tyre equator C to each side thereof by an axial distance of 10 % of the tread width TW between the tread edges To and Ti.

[0024] Preferably, the outside tread part provided with the axial grooves 3 and circumferential grooves 6 extends slightly beyond the tyre equator C, and thus, the inside tread part provided with the axial grooves 5 and circumferential grooves 7 extends to a position before the tyre equator C. In practice, however, to change the tread pattern smoothly from the outside tread part to the inside tread part, a transitional part is preferably formed therebetween.

[0025] Next, a more practical example will be described in conjunction with Figs.2 and 3 which also show a left tyre 1L.

[0026] In this example, the outside axial grooves 3 have a zigzag configuration which is formed by overlapping straight groove components 9 successively in a step-like form. The overlap is almost one half length of each component. Each straight component 9 is parallel to the tyre axial direction, but each of the outside axial grooves 3 as a whole is inclined as explained above. In this case or in the case of a zigzag groove, the above-mentioned inclination angle α is defined from a straight line X1 drawn between the inner end il and the outer end ol or the centre line of the zigzag amplitude. Apart from straight or zigzag configurations, curved configurations may be used for the outside axial grooves 3.

[0027] The outside circumferential grooves 6 in this example also have a zigzag configuration which is formed by providing a short axial component in the middle of the length. Also, apart from straight or zigzag configurations, curved configurations may be used. The above-mentioned inclination angle γ is defined using a straight line X3 drawn between the inner nd i3 and the outer end o3 or the centre line of the zigzag amplitude. In this example, two circumferential components 11 on both side of the axial component are straight and each satisfies the above-mentioned limitation for the angle γ.

[0028] In a region surrounded by the tyre equator C, the outside tread edge To, and circumferentially adjacent two outside axial grooves 3, three outside circumferential grooves 6 are disposed. On the inside of the tyre equator C or

in the above-mentioned transitional part, a further circumferential groove 13 is disposed, which is almost the same as the outside circumferential groove 6 in respect of the configuration and inclination.

[0029] The inside axial grooves 5 in this example comprise straight grooves 5A and zigzag grooves 5B which are alternately arranged in the circumferential direction. The straight grooves 5A are parallel to the axial direction. The straight grooves 5A align with and are connected with the innermost straight components of the outside axial grooves 3. The zigzag grooves 5B are each composed of axial components parallel to the axial direction and two short circumferential components parallel to the circumferential direction. Each zigzag groove 5B taken as a whole is substantially parallel to the axial direction. The zigzag grooves 5B are each opened to one of the circumferential grooves 13 in the middle of the length.

[0030] The inside circumferential grooves 7 are straight and inclined at an angle δ of less than 1/2 of the angle γ as explained above.

[0031] In this embodiment, further, tie-bars 160 and 16i extending between adjacent blocks are provided. In the outside part, tie-bars 160 are disposed in the circumferential grooves 6 (first and third grooves from the outside tread edge To) to connect the axially adjacent blocks in pairs to increase the lateral stiffness and thereby improve cornering force and uneven wear. In the inside part, tie-bars 16i are disposed in the axial grooves 5B to connect the circumferentially adjacent blocks in pairs to increase circumferential stiffness and thereby improve traction and uneven wear.

[0032] Therefore, in the outside tread part, four rows of blocks Bo are formed. The blocks Bo have a shape which is generally a circumferentially elongated parallelogram like a periscope. The front and rear edges 10 thereof are substantially parallel to the tyre axial direction although the outside axial groove as a whole inclines at the angle α. As to the side edges, the greater part thereof inclines at the angle γ.

[0033] In the inside tread part, two rows of blocks Bi are formed. The blocks Bi has a shape which is generally an axially elongated trapezoid. The edges 12 facing the axial grooves 5A and the greater part of the edges facing the axial grooves 5B incline at the angle β and are substantially parallel to the tyre axial direction. The side edges facing the inside circumferential grooves 7 incline at the angle δ.

[0034] Incidentally, in the transitional part between the outside and inside tread parts, a circumferentially continuous groove 2 is formed by the circumferential grooves 13 and axial groove components 13. It is possible to provide a circumferentially continuous straight groove instead of zigzag groove. However, a zigzag shape is preferable. In the case of zigzag, it is preferable that the centre of the zigzag is within the above-mentioned tread centre region YC and the tyre equator C is within the amplitude of the zigzag.

[0035] As to the widths and depths of the above-mentioned grooves 2, 3, 5, 6 and 7, values which are usually employed in off-road tyres, for example a width of 4 to 20 mm and a depth of 6 to 15 mm may be employed. In this example, the grooves 2, 3, 5, 6 and 7 are the same depth, but they may be differed.

Comparison Tests

[0036] Plural pairs of right and left tyres in a size of 205/65R15 were prepared and tested for traction, side grip and off-road lap time. The tyres had the same structure except for the tread patterns. The specifications of the test tyres and the test results are shown in Table 1. The test tyres were mounted on four wheels of a 4WD-car (2000cc) as shown in Fig.1. On an off-road circuit course of 2.2 km, the lap time was measured, and at the same time, the traction and side grip were evaluated into five ranks by the test driver's feeling. The larger the value, the better the performance.

Table 1

	Ex.1	Ref.1	Ref.2	Ref.3
Tread pattern				
Left	Fig.2	Fig.2	Fig.2	Fig.5
Right	Inverse	Inverse	Inverse	Fig.5
angle α (deg.)	85	90	40	-
angle β (deg.)	90	90	70	-
angle γ (deg.)	20	5	50	-
angle δ (deg.)	10	0	20	-
Test Results				
Traction	4	3.5	3	3
Side grip	4	3.5	3	3
Lap time	1'34"0	1'34"5	1'35"1	1'35"5

[0037] As shown in Table 1, the pneumatic tyres according to the present invention were greatly improved in both off-road traction and side grip and displayed good road ability. When the angles α, β, γ were outside the above-mentioned range and the inclination directions of the grooves were different from the above, it was not possible to improve both the off-road traction and the side grip at the same time.

[0038] The present invention can be suitably applied to pneumatic tyres for off-road use such as rally, dirt trial and the like and to non-pneumatic tyres.

Claims

1. A vehicle tyre comprising a tread having an outside tread edge (To) and an inside tread edge (Ti) to be placed on the outside and inside of a vehicle respectively, the tread comprising an inside tread part extending from the inside tread edge (Ti) toward the tyre equator (C) and an outside tread part extending from the outside tread edge (To) toward the tyre equator (C), the inside tread part being provided with inside axial grooves (5) extending axially across this part so as to circumferentially divide this part into inside blocks (Bi), the outside tread part being provided with outside axial grooves (3) extending axially across this part and outside circumferential grooves (6) each extending between the circumferentially adjacent outside axial grooves so as to circumferentially and axially divide this part into outside blocks (Bo), characterised in that when looking down on the tyre, the outside axial grooves (3) are inclined towards one direction such that the outer ends (o1) thereof are positioned backward of the inner ends (i1) in respect of the intended travelling direction, the inclination angle α of the outside axial grooves (3) is in the range of from 60 to 80 degrees with respect to the tyre equator (C), the outside circumferential grooves (6) are inclined toward one direction such that the outer ends (o3) thereof are positioned forward of the inner ends (i3), the inclination angle γ of the outside circumferential grooves (6) is in the range of from 15 to 45 degrees with respect to the tyre equator (C), the inside axial grooves (5) are inclined at an angle β of 80 to 110 degrees with respect to the tyre equator (C).

2. A vehicle tyre according to claim 1, characterised in that the longitudinal directions of the outside blocks (Bo) are generally circumferential, and the longitudinal directions of the inside blocks (Bi) are generally axial.

3. A vehicle tyre according to claim 1 or 2, characterised in that the inside tread part is provided with inside circumferential grooves (7) each extending between the circumferentially adjacent inside axial grooves (5) and the inside circumferential grooves are inclined towards the same direction as the outside circumferential grooves, at an angle δ of less than the angle γ.

4. A vehicle tyre according to claim 3, characterised in that angle δ is less than ½ angle γ.

5. A vehicle tyre according to any of claims 1 to 4, characterised in that the outside axial grooves have a step-formed configuration, and the front and rear edges of the outside blocks are substantially parallel to the axial direction.

Fig.1

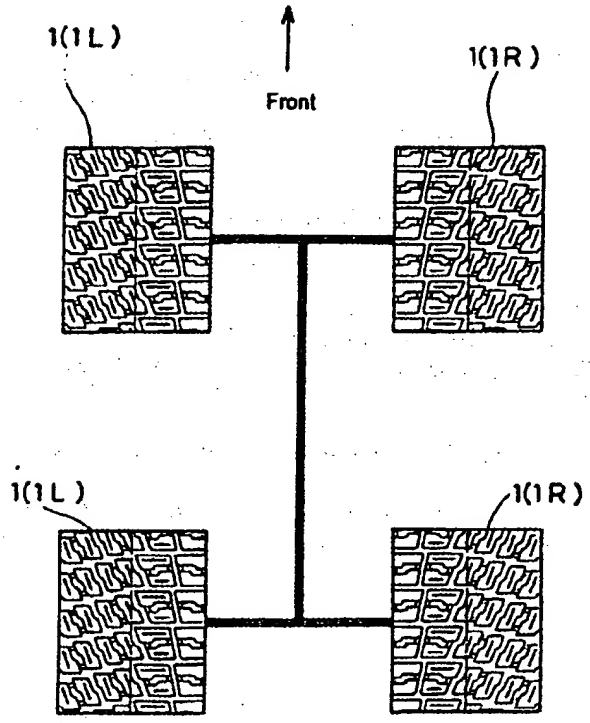
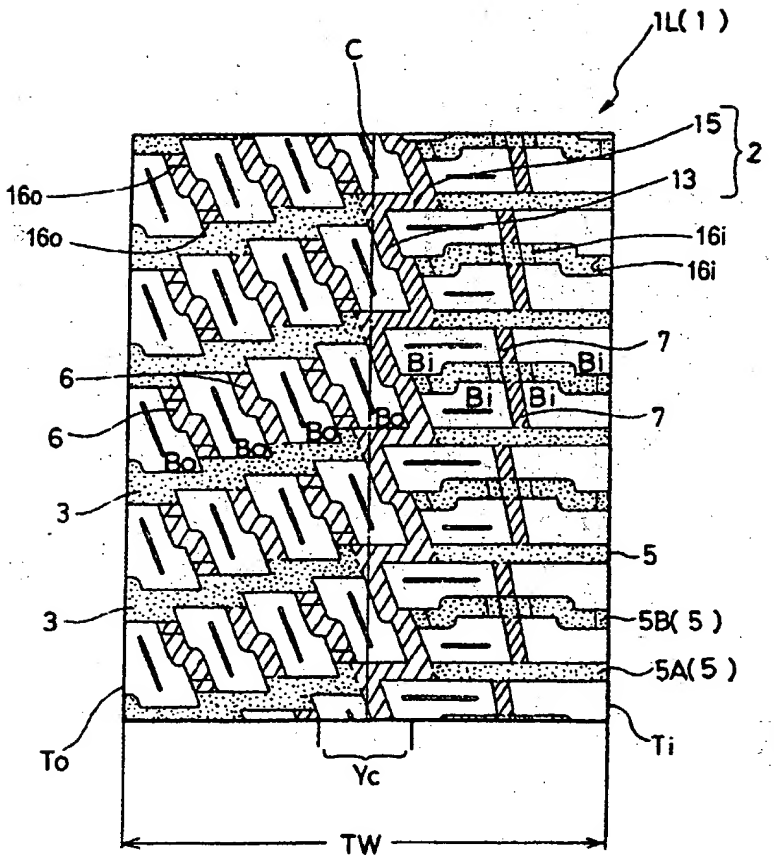


Fig.2



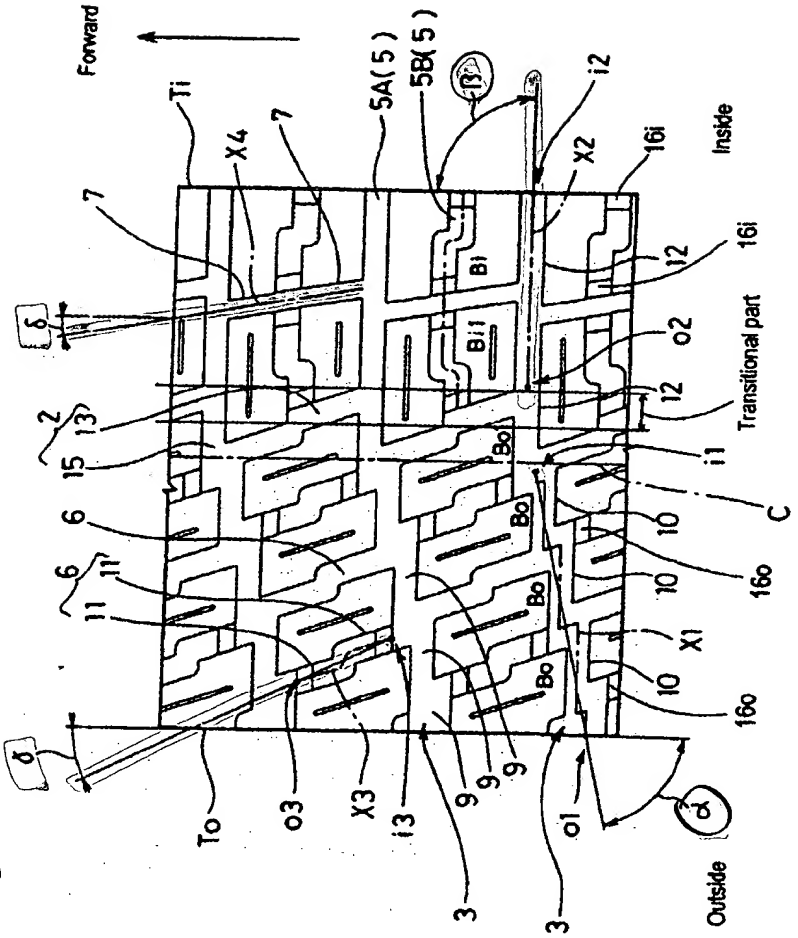


Fig.3

Fig.4

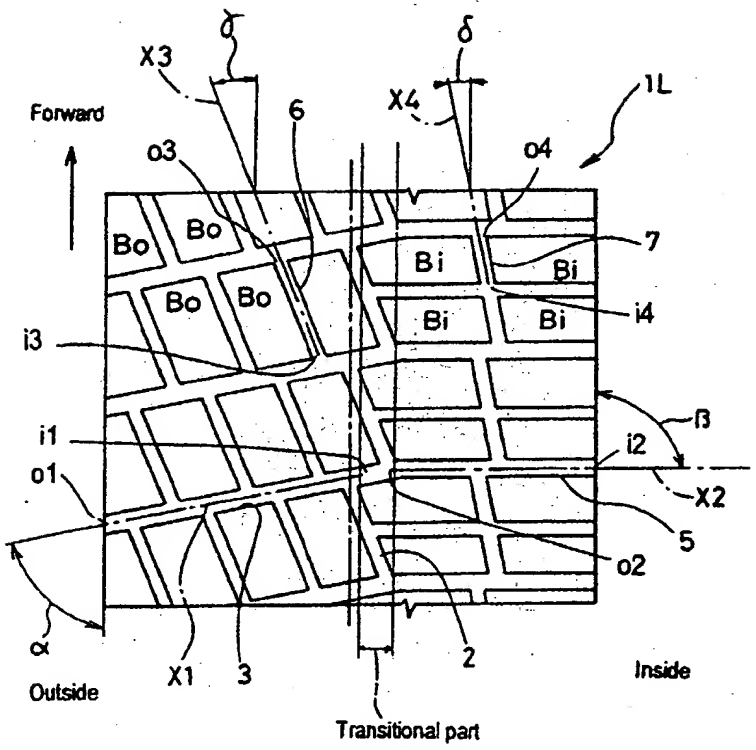


Fig.5